Robert L. Bates

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Journal of Geological Education

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PHILOSOPHICAL AND GEOMETRIC PERSPECTIVES AS AIDS IN THE TEACHING OF STRUCTURAL GEOLOGY*

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ABSTRACT. The philosophical perspective of lecture and laboratory courses in structural geology is that they are transitional and analytical studies between the elementary courses (physical and historical geology) and the first course in field geology. The opinion is here supported that structural geology should consciously be taught to exercise and test abilities different from those usually emphasized in the elementary courses. Reasoning rather than memory is encouraged by analyzing carefully described geologic situations much as they would be unfolded by outcrop studies during field work. This method inevitably leads to practice of the second perspective, the geometric, by which the student is forced into thinking in three dimensions just as the geologist must think in the field. Sample situations are developed to illustrate the two perspectives and their interrelationships.

There are two related perspectives, philosophical and geometric, which I try to keep in focus in teaching structural geology.

The first, or philosophical, has to do with the logical and most effective place for the course in a curriculum attempting to provide complete training in the fundamentals of geology. In some colleges structural geology is an incidental elective, and in others it is a course open only to graduate students. In either case, it may be almost entirely descriptive—concerned particularly with dividing and subdividing folds and faults down to the very finest scratches on the component grains.

I have always considered its proper place to be immediately following historical geology so it can serve specifically a transitional role between the comfortable laws and facts of physical and historical geology, on the one hand, and the tortuous syntheses of dimly related observations in the field, on the other. In other words, I consider structural geology as a transitional and analytical study between the elementary courses and the first course in field geology. Mineralogy and paleontology may well be taken concurrently but could also follow. All other geology courses, such as the economic branches, geomorphology, sedimentation, and stratigraphy, should definitely follow.

I believe that structural geology should consciously be taught so as to exercise and test a set of abilities different from those normally reached in the elementary courses. The emphasis should be on developing the students' reasoning powers, and the introduction of involved descriptive terminology should be minimized.

* Presented on March 29, 1956, at the sixth annual meeting of the Eastern Section of the Association of Geology Teachers, at West Virginia University, Morgantown, West Virginia.

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Some new terms and definitions are required, but as far as possible those terms learned in physical and historical geology should be used, reused, and qualified so as to insure retention through the years.

For instance, in considering varieties of folds based on the relationship of bedding planes in them it is poor testing, when the foregoing philosophy is in focus, to ask for definitions of similar and parallel folds. Rather, I would inquire where, with respect to one, would the other most likely be found in a vertical section of the earth's crust. A logical answer not only conjures up mental pictures of the two kinds of folds, but also opens up problems concerning environment, plasticity, geothermal gradients, confining pressures, rigidity, solid flow, bedding plane faulting—in fact, all the many inherent and environmental variables that influence folding.

In helping to prepare the student for field mapping, we must teach him not only the names of geological features but, more important, where to find them, and how to recognize and describe them according to standard form even though they may be more or less covered, dislocated, or eroded at many angles. Perhaps the journalists would say that the emphasis should be less on *who* and *what* and more on *where, when, how,* and *why.*

If it is possible to describe a field situation or draw it on the board and teach from that, I do so because this further prepares a student to think for himself in the field. One of the most continuing efforts is to persuade students to think in terms of compass directions and degrees of dip, rather than in terms of right or left and up or down. In examinations, I repeat the process. For instance, rather than ask the student to describe the theories for the origin of *en echelon* faults, I might describe a field situation and ask questions concerning it. The following is an example:

A north-trending fault exists beneath an unconformity over which there are 800 feet of horizontal consolidated sediments. Strike-slip movement occurs along the old fault, displacing the eastern side relatively southward and forming *en echelon* faults in the overlying sediments.

a. By map diagram show the trend of the fault zone and also the trend of the individual faults.

b. Are the faults most likely to be high angle or low angle?

c. Are the faults most likely to be normal or reverse?

d. If folds were formed at the same time and under the same stresses as the *en echelon* faults, what would be their strike?

In this approach, definitions are important only insofar as they help the student describe a field situation and are not considered ends of teaching or measures of the student's knowledge of the subject. It follows that the first examination in a course of this type often comes as a shock despite efforts to cushion its impact. Many students judge the nature of all geologic studies from the elementary courses, in which the multiple-choice question or even the true-false type is necessitated by class size and the enormous amount of material covered. Some students decide to major in geology only because they were rather effortlessly able to earn A's or B's in the elementary courses, and they find themselves disenchanted with the whole field after receiving a D in structural geology. However, for students to realize the nature of professional geology at least that early in their course work would seem more desirable than for them later on to find themselves incompetent or in a field not to their liking or abilities. Most students soon learn to visualize the given

situations and solve the requirements as they would in the field and are thus better able to make the transition. As a matter of fact, many find that the different approach is stimulating; they accept it as a challenge, and are rather happy to find a course where pages of reading assignments are at a minimum and mental exercise in class is at a maximum.

The second perspective I try to keep in focus is that the student must finish the course better able to consider and visualize rock sections in three dimensions. To this end, strike and dip notations are used to set up situations for analysis whenever practicable. The student normally first applies definitions of strike and dip to simple cross-section and geologic-map problems in physical geology laboratory and works with additional problems of like nature in historical geology laboratory. By that time he has at least seen a Brunton compass and learned its general uses. These fundamentals are reviewed again in structural geology lecture, and the problems are made more complex in structural geology laboratory. A standard method of notation is adopted with direction of strike given first, amount of dip second, and direction of dip last. The use of quadrant readings is practiced because the student is often to that point more familiar with azimuths.

I use the strain ellipsoid in the study of structures, not because it has any practical quantitative value but purely as a disciplinary measure to force thinking in the three dimensions necessary in field mapping. Some methods of directing thought into three dimensions are illustrated in the following family of questions taken from a recent preliminary examination:

Field work in central Oklahoma discloses a number of high-angle normal faults which intersect at depth. The average attitude of the faults in one set is N28E 60 N62W, whereas the faults of the other set average N31E 55 S59E. Some faults of both sets displace faults of the other set.

a. Describe the proper orientation of the major axes of the strain ellipsoid (by compass direction and/or inclination as the case may be) to explain the faulting.

b. Has the faulted section reacted to the breaking stress as brittle or ductile material? Explain the evidence for your answer.

c. What is the general age relationship between the two sets of faults? Explain the evidence for your answer.

d. In addition to the term "normal," what two other terms may be applied to the faults, considering the relative movement of adjacent blocks?

e. Beds of the faulted region strike N 5 W. As seen in plan view, what term may be applied to the fault because of this feature?

f. At one place on one of the faults, a stratigraphic throw of 1200 feet was measured. Just what does this mean?

g. The relative movement of the sections between the faults produced two types of structural units which at the time of the faulting had surface or topographic expression. Name these two types of structural units.

Relating a number of questions to a particular field situation rather than getting at them by abstract classroom discourse has had encouraging results in my teaching. I have come to the conclusion that the philosophical perspective of structural geology as directly transitional to field geology dictates the use of the three-dimensional geometric perspective as a teaching aid. In lecture, the extent to which the method is followed might be measured by the consumption of chalk for the drawing of sections, block diagrams, and maps on the blackboard. In the laboratory, the method emphasizes graphic or stereonet solutions of thickness, depth, true and

apparent dip, and outcrop delineations rather than solutions through formulas and direct trigonometric substitution.

I should like to emphasize that these perspectives must be very consciously brought into focus as the teacher develops every classroom explanation, otherwise the method loses value. There are easier ways to complete a course in structural geology from both the teacher's and the students' viewpoints, but I believe there is no better way to teach or learn structural geology than to integrate it solidly into the step-by-step development of the fundamentals of geology through the college curriculum in this manner.

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KEY TO A MORE EFFICIENT AND EFFECTIVE ELEMENTARY GEOLOGY COURSE*

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ABSTRACT. Although much of the General-Education value of geology lies in its essential inclusion of basic principles of other natural sciences, still more valuable is the essence of geology itself: history of the Earth and evolution of its inhabitants. This necessary involvement with the other sciences can result in introductory courses replete with applied chemistry and physics and the mechanics of landscape development, with (from the student's viewpoint) an incomprehensible afterthought summarizing what should be the main theme—Earth history. To the extent that such relative neglect of Earth history prevails, the educated public is denied the chance to gain a true appreciation of geologic science. This aids the shift of educational attention to devices such as survey courses.

Our first responsibility is to organize the other sciences around the science of Earth history and evolutionary development, so that our students may learn to interpret the geologic past, at least in elementary fashion. Such an introductory course affords appropriate background for any type of future specialization. It meets our obligations to both future geologists and non-geologists most effectively because of its continuing emphasis on the interrelations of the geologic past and present.

New discoveries and techniques in geochemistry and geophysics will enrich, but should never supersede, the study of Earth history.

I

Geology teachers everywhere are faced with two problems. The more obvious one is to teach our future geologists more and better geology in the same time as heretofore (or in less time). The other, though less clearly defined, is even more important because it concerns every student in our elementary classes—future majors and non-majors alike. It is that we must give them that insight into geologic science which will be of greatest help toward a proper orientation in the modern world. Such insight into the several disciplines at the collegiate level should constitute general education. Our students are entitled to this kind of help; but many elementary geology courses at present are falling far short of their inherent possibilities. To the extent that we are failing in this, we are contributing to that unsatisfaction or dissatisfaction (if not actual distrust) out of which has grown the desire for science-survey courses commonly included in so-called "General Education." To the best of my knowledge, these survey courses cannot go deep enough to afford the non-scientist an anchor, as it were, for significant understanding; and for future scientists these courses cannot serve as prerequisites to further work in any one field and are therefore an additional barrier to progress.

Of all the physical sciences, geology touches the most broadly and vitally upon the life and destiny of Man. It still encompasses much of what was once called natural philosophy; and because of this, it affords the ideal basis for orientation in

* Presented on November 7, 1955, at the fifth annual meeting of the Association of Geology Teachers at New Orleans, Louisiana. This paper was part of a symposium on the impact of General Education on the curriculum in geology.

the whole field of the natural sciences. Not only does it form a setting for the high lights of chemistry, physics, and biology, but also it borders broadly on all philosophic problems of modern life. Some geology teachers may shun the philosophic aspects of geology for one reason or another; but in so doing they are narrowing their field of service and impoverishing their courses. If it be argued that geology teachers generally are not trained in the humanistic aspects of science, the answer is that for at least three generations the teaching of geology in many colleges has been needlessly sterile in these respects. Humanistic values in geology are best imparted by incidental reference, as sidelighting on typical geologic problems, and by personal attitude and example. They can hardly be made a required part of the course, but my experience indicates that students are eager for these ideas and any special emphasis is quite unnecessary.

In this paper I shall explain why I believe the conventional plan of teaching geology is relatively inefficient for future geologists, and increasingly ineffective for all students in setting forth the great potential value of our science. From experience, I am convinced that we can greatly improve our service to all students by reorganizing and integrating our work at the elementary level.

The fact there is now so much room for improvement in our elementary courses stems from our philosophy of geologic education, which has remained static for nearly three quarters of a century. Its basic assumption is that physical geology must precede historical geology. Earth history, which is the central and unique theme of geology, has been gradually pushed into the background because of the vast expansion of physical geology. With all good intentions, we are unduly subordinating the historical study under the highly questionable pretext that our students must first learn an arbitrarily prescribed amount of physical geology. This is, of course, one way of accomplishing our task. But some decades ago, a few teachers with commendable originality perceived that the plan was neither efficient nor in harmony with the best principles of educational psychology. The chief reason why the orthodox scheme of subject-matter organization has persisted is that, as others have said, geology teachers are ultraconservative and "tend to teach as they themselves were taught." I cannot believe, however, that our profession has lost all originality and desire for improvement of method.

Even though the orthodox physical-historical sequence of presentation was suitable for elementary instruction during the early years of its operation, our situation today demands a degree of efficiency which that time-honored system does not possess. In the words of the poet:

> New occasions teach new duties;
> Time makes ancient good uncouth.

We must make available to our students the best of geologic thought on physical phenomena unknown or unrecognized in the 1880's; but also, and equally important, we must not neglect the new knowledge of Earth history and life development now available, which is especially significant at the elementary or General-Education level of instruction. My preferred solution to our problem is to merge the physical and historical components into an interconnected unit that can take immediate advantage of those complementary and inseparable relationships between the two phases of geology—the geologic past and present. The practicality of this type of integrated course was clearly demonstrated years ago, although it received no pub-

licity at that time so far as I know. It is by no means a recent innovation, and its possibilities for increasing our efficiency deserve recognition.

Also for the record, I must offer my own experimental evidence. For more than five years now I have taught elementary geology as an integrated course (5 semester hours of credit) in which the essential physical principles are given their appropriate historical setting, following the integrated plan. Student comprehension, response, and enthusiasm far exceed the results of my earlier teaching; and for me that is a rewarding experience. Therefore, in the interest of improving our service to both future geologists and non-geologists, every loyal teacher is hereby invited to share in a critical appraisal of our present educational situation.

II

There is no disagreement among geologists as to what geology is: history of the Earth and evolution of its inhabitants. When two geologists meet and discuss their work, whether it be ore deposits or peneplains, their whole framework of reference is that of field facts interpreted as geologic history, true to our definition. Time, that fourth dimension on a grand scale, is at the center of geologic science. To give the fullest possible appreciation of it is a most significant contribution to General Education which no other college course can give; and that is what an elementary student would begin to learn about at once if only he could associate with a real working geologist instead of with a mere geology teacher.

Now many a geology teacher is also a part-time practicing geologist; yet when he returns to his classroom his pattern of thought reverts, from long habit, to the familiar Huttonian dictum that "the present is the key to the past," and thereupon he carefully guards his new students from any serious questions about the geologic past until they have mastered his course in physical geology—though some teachers may talk down to their students about such topics as "geological clocks." Uncritical acceptance of Hutton's ancient bit of wisdom now for several generations has almost completely petrified all educational thought on the subject. Almost without our realizing it, the length of time consumed in key-making has increased with the growth of physical geology until, in many colleges, the key has grown to such ponderous proportions that it not only outweighs the lock but also overshadows all that the student ever sees beyond it. The unlocking process has been gradually relegated to a secondary status or omitted altogether. With such treatment, many a student gains a very disorted and inadequate idea of what geology is because of what his introduction to the subject has turned out to be. I am not saying that the study of rocks, minerals, and glaciers is uninteresting. The important consideration is that the essence of geology is historical and lies back of and beyond these physical materials and processes. It includes these things, but *definitely more*. When these topics are put in their proper historical setting, the learning process goes on along two lines at once, with twice the student interest and with considerable economy of time and teaching effort. This is the way in which geologists think, and only in this way can the student have the best chance to understand the principles of geologic work and to perceive the broad foundations for philosophic interpretation of life development, natural resources, and continental history.

To teach about glaciers and mountain structures merely as phenomena of the present, out of their historical context, is to put them in a geologic vacuum, devoid

of significance other than that they form parts of our modern scenery. It is quite like studying wild animals in iron cages at the circus instead of in their natural habitats when the latter can be done just as easily as the former.

Hutton, no less than ourselves, was trying to understand the present; and implicit in his expression about the past is the greater truth that the past is the key to the present, in the same sense that a knowledge of political and social history is essential to intelligent living in our modern society. Our familiar quotation has not done justice to the scope of Hutton's thought because we have taken it out of context.

III

Three aspects of the physical-geology problem require careful thought. First, we should consider to what great proportions this part of our domain has grown, and evaluate it in terms of what should be included in a balanced course for students who may not take further courses. Second, we should re-examine the assumption that a good part of physical geology, as it is now constituted, is essential to beginning a sound understanding of historical geology. Third, we should study how our science can be taught *and learned* most effectively and efficiently. This is most essential because of the ever-growing need to learn more and more in less and less time. Sound integration is the logical key to maximum efficiency.

The general policy of requiring physical geology before historical became fixed in our scheme of education about 1890. In a relative sense, our knowledge of physical processes then was rather elementary, but its growth was rapid and the new material interesting. In recent decades its growth has been phenomenal. One has but to read the advertisements of new editions of well-known physical-geology texts to see how great is the additive process. Chapters have been expanded to include this and that new development. Treatment of this and that topic has been revised to include recent results in several new fields. Entire new chapters have been added here and there. And almost nothing has been omitted. One recent text boasts of "introductory" chapters on atomic structure and physical-chemical principles for which even the pre-professional student has no real need until he is nearly ready for graduate school, yet blithely offered to the general elementary "student with no previous background in science." To my way of thinking, this is the height of folly in geologic education. Some men who are now deans went through far less frustrating experiences in their geology courses a few decades ago and are now among the chief advocates of science-survey courses. If our future deans are bright enough to survive this kind of geology course, they are likewise bright enough to see its futility, especially for the non-professional student—the 98 per cent of the average elementary class.

Partial explanation for our present problems lies in the recent intensive cultivation of the borderlands wherein geology merges with physics, chemistry, and engineering. Much of the new material grafted onto physical-geology courses can be claimed just as legitimately by one or another of these disciplines. Whereas all this material has real significance at some level of geologic training, the great problem is to discern what parts of it are suitable for integration into a well-balanced elementary course, and then how to effect that integration. A given item should be excluded until it can be shown to be vital at the elementary level and can be included without crowding out something else more vital. These are problems for the geology teacher to solve, but in common practice they are ignored on

the assumption that the textbook writer has already rendered an expert final opinion. I contend that long ago we left that stage of expansion at which a bigger and tougher text could make a better and more effective general course.

IV

The chief argument for requiring physical geology before historical is the assertion that historical geology is incomprehensible to a student who has not had the physical course. Like many another work of fiction, this one also is founded on fact. The central question is: How much physical-geology background is really necessary? The answer is: Not much, provided that the teacher is skillful and alert. Much of what would have been called physical geology in Hutton's day is now common knowledge among our young people, most of whom have traveled at least moderate distances, have read somewhat in the newspapers, and have seen the newsreels at the movies. Even those freshmen who have studied neither physics nor chemistry in high school still possess many keys to the past if only their teachers would realize it. Naturally, they need a systematic introduction to minerals and rocks before attempting to read history from them, but historical study *can* be the next step. Thus begun, the present processes and the results of their operation through the past are logically inseparable. Learning about the one reinforces the other, and together they form the true basis for geological understanding. In talking with students taught in this manner, it is both interesting and significant that they cannot see any logic in separating physical and historical geology.

V

The integrated course, organized historically, is of necessity developmental and therefore somewhat less flexible than one with topical arrangement. It requires a vocabulary of simple terms suitable to all geology for use during the early weeks of the course, and the teacher must be keenly and constantly aware of his students' progress in acquiring a working vocabulary of ordinary technical terms. A common error under any scheme is the inadvertent use of technical terms before their meaning has been adequately comprehended. A teacher using the integrated plan for the first time must be especially watchful on this score because of the tendency to assume too much student familiarity with conventional physical geology.

Introductory lessons should sketch broadly the full extent of the field of geology before taking up a detailed study of Earth materials. This initial orientation serves throughout the course to keep the student aware of the broad relationships that give details their signficance. Therein lies one of the great advantages of the integrated course, because the whole field is always in view. Rock structure becomes a part of mountain-range development as the historical study proceeds. Coal and other rocks of economic value likewise have a proper historical setting to account for their origin and geographic distribution. Cenozoic history forms the essential background for topics such as shoreline features and processes, earthquakes, and the striking contrasts between eastern and western North America. The study of glaciation in its essential Pleistocene setting is especially appropriate and advantageous in giving perspective to the geologic status of the present.

Details of stream erosion may well dominate a consideration of modern geologic changes. Coming late in the course, a prime advantage is that free and intelligent reference to the geologic history of any area can be made in order to explain regional

differences in lithology, structure, and other characteristics. Such historical reference is also good incidental review. The basic dependence of the present on the geologic past needs no argument; and the integrated course gives the student the best possible chance to gain this fundamental four-dimensional perspective of the world in which he lives.

To gain a concept of the immensity of geologic time is more satisfying than to contemplate the vastness of astronomic space because we can place our hands on actual rock specimens and fossil forms that have endured these hundreds of millions of years. To measure against this scale the progress of life development, noting the clues to environmental adaptation, affords the soundest possible basis for interpreting the geologic present, even including the place and worth of the individual. Evaluation in these matters rests here on hard geologic facts. It is part of that unity of present and past, past and present.

Adequate appreciation of geologic time cannot be gained within a month or two, and the bland assumption that it can be thus acquired is one of the most serious shortcomings of the conventional plan. It requires repeated thought in connection with various other geologic concepts. It should begin with the first lesson, and no general course can exhaust the possibilities of educational enrichment by repeated reference to geologic dates and the actual or relative time duration which they represent (of course within the limits of our present knowledge). Future majors and non-majors alike are entitled to all possible help in finding vital significance in geologic knowledge. The teacher who ignores this is failing in his educational responsibilities.

VI

To summarize, the integrated elementary course fulfills best the spirit of Huttonian doctrine that "the present is the key to the past." Coverage of physical geology can be as complete as the teacher wishes to make it, within the limits of available time. Physical principles have their best and most effective illustrations in actual examples as they come in the historical development; though it is important to realize that not all aspects of a given physical-geology topic can be, or need be, covered in connection with a single historical episode. There is, however, an actual saving of time because the historical events and physical principles are learned simultaneously. Moreover, there are ample opportunities for review and synthesis. Material presented early in the course is not forgotten because it is frequently needed to illuminate topics presented under discussion. The entire course develops naturally as an interwoven unit, and the future major is well oriented in beginning his professional training. There are no "blind spots" and no long-deferred additional areas or topics to crop up unexpectedly at a later date. With this basic integration, each of his future courses has an already-recognized place in the overall plan and helps to round out the complete field.

Teaching an integrated course is the best guarantee of giving the non-major a truly representative picture of what geologic science is and how geologists go about their work. It is the most direct, forthright, and easily comprehended approach to the whole field. Moreover, it centers the course on the most distinctive part of geologic science—Earth history. For the able and alert teacher who has not tried it, and who wishes to increase the effectiveness of his elementary teaching, the integrated course offers a worthwhile opportunity.

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NEW AREAS IN GEOLOGY: A SECONDARY-SCHOOL COURSE IN HISTORICAL GEOLOGY*

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ABSTRACT. The general public thinks of geology chiefly in terms of its hobby aspect and its economic aspects and concludes that it is therefore of interest to relatively few people. What we need to emphasize in our teaching, in order to arouse more general interest in the subject, is the great middle ground of geology—its influence on the political, social, and cultural life of man and its relationships with other school subjects. This is what the author tries to do in his secondary-school course in historical geology. In this paper he describes and illustrates his procedures and gives the reading list used in the course. The value of collateral reading is stressed.

A small handful of concerned people are today making heroic efforts to restore geology to its rightful position in the secondary-school curriculum. Earth science, as such, has practically disappeared from our schools. Not only is this a deplorable thing in itself, but college geology departments also stand to lose, for with many students college work is a continuation of study in areas where they have at least some background.

Where have we fallen down and what has been wrong with our salesmanship? I have a thesis which I would like to propound at this point, and it is this: In general, the public looks upon geology as being concerned with only two areas. One of these is the hobby aspect of the subject. A geologist, then, is one who has a wonderful time digging and beating upon the rocks in a quarry. He is simply an enthusiastic collector of rocks and pretty crystals. But, reasons the public, only a few of us would ever wish to follow up this type of interest. The other great area of interest with which this subject is concerned, so reasons the public, is such economic aspects as oil geology, mining engineering, etc. Here again the alleged man in the street could argue that this is all very fine, but only a very few of us are going to be oil geologists, so let us just teach things in school that everyone can use and enjoy.

What we haven't done is to emphasize the great middle ground of geology. We have by-passed too often its great political, social, and cultural aspects. What is more, there are a host of points of contact and "tie-ins" with other school subjects. Here, indeed, is something that all can enjoy. In a small way I have tried to proceed along these lines in the school where I teach geology. Let me illustrate by means of some comments on my course in historical geology at Germantown Friends School.

I use a college textbook but only give selected readings in it. The students keep a notebook in which they summarize the text assignments, keep a record of the

* Presented on April 16, 1955, at the fifth annual meeting of the Eastern Section of the Association of Geology Teachers, at Franklin and Marshall College, Lancaster, Pennsylvania. This paper was part of a symposium on teaching geology in secondary schools.

information I give them, and also write short summaries of collateral reading. This last is very important and is really the open-ended feature of the course. I set a "par" amount of work that will give a respectable grade and then suggest that if students, through interest plus having available time, see fit to double "par" in their outside reading they will get an *I* or *A*. This is what the great majority do. Perhaps this is a low form of bait, but then again perhaps it isn't. You can't read an extra book or three or four additional magazine articles without getting something out of it.

In this course there are field trips and study of fossils, as might be expected in any work in historical geology. What is different, however, is the amount of reading the students do. This, itself, is enough to reveal possibilities for correlation and points of contact with other fields. As these books are read it becomes increasingly clear that geology is a part of the very fabric of life itself. I will try to be specific.

The Sea Around Us is read as a textbook after a consideration of the Ordovician. It brings to life the whole problem of the relationships of the sea and cosmopolitan climates.

With the Silurian I take the time to consider the problem of aridity in general as well as in certain specific places, such as Australia. I encourage the students to read a travel book on Australia at this point.

The Pensylvanian, Permian, and Cretaceous periods offer a host of areas for collateral study, extending from the Carboniferous mountains of central Europe to our own Alleghenies. The influence of geology in history is very apropos at this point. As an illustration, note that the Ardennes form a natural boundary between France and Germany but for some reason founder in Belgium, making that country the agreed-on battle ground of Europe. A great deal more can be done here to show the influences of topography upon the whole way of life of a people. Consider, for example, Poland's lack of physical boundaries, the lack of navigable rivers in Spain, and the effects of the central massifs of France and Spain, Norway's fjords, and the highlands of Brittany.

A very great opportunity comes with the study of Pleistocene glaciation. When one stops to think of our own Great Lakes, to say nothing of the great numbers of lakes in the North Central states, New York, and New England, with their effects on transportation, flood control, agriculture, and the tourist trade, it is an impressive picture. Many other features stemming from glaciation may be discussed. These could include, for example, the Canadian wheat fields, New England's soil, and New England's drowned shore line. A curious footnote to history in relation to the drowned shore line is the very direct relation between it and New England's early mercantile interests. However, because of this shipping we almost lost New England during the War of 1812. Remember the Hartford Convention? We could have blamed the glacier if that had happened.

As thought-provoking as some of this physical material may be, the chief interest of secondary-school students is centered around the evolution of life. They are intrigued with the staying power of life forms. We still have the evergreens. For that matter, we still have lung fish. In considering the Devonian, one book that helps to bring it alive is Homer Smith's *Kamongo*. There is a very absorbing tie-in here with religion and philosophy. It is quite gratifying, as well as pleasantly sur-

prising, to see how well secondary-school students take to problems involving conceptual thought.

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In the appended reading list eight books (Bates, 1952; Chase, 1936; Collis, 1954; de Castro, 1952; Mather, 1944; Osborn, 1952, 1953; Vogt, 1948) are concerned with our problem of getting enough to eat. Along with this goes a considered study of what man has done to the soil on this earth—a rather gloomy picture. A more cheerful note is sounded by others (Allee, 1951; Hawkes, 1951; Huntington, 1927; Mills, 1942; Montagu, 1950, 1952). Thanks to W. C. Allee (1951), for example, a whole new outlook is developed on the evolution of the past as well as the possible picture of the future.

Aesthetics and geology are most surely not mutually self-contradictory. On the contrary, our subject and its inherent implications offer tremendous opportunities for significant and creative writing. As examples of the possibilities, every English teacher should know the works of Rachel Carson, Jacquetta Hawkes, Homer Smith, Marston Bates, and Stuart Collis.

To anyone who is concerned to see the study of the Earth receive its proper recognition it is more than apparent that in the examples given in this paper I have barely touched the surface of the great middle ground of geology—that middle ground of appreciations that may give new meaning to a host of things we read, think, and do.

READING LIST

Allee, W. C., 1951, Cooperation among animals: New York, H. Schuman.
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Bates, M., 1952, Where winter never comes: New York, Charles Scribner's Sons.
*Carson, R., 1951, The sea around us: New York, Oxford Press.
Chapin, H., and Smith, F. G. W., 1952, The ocean river: New York, Charles Scribner's Sons.
Chase, S., 1936, Rich land, poor land: New York, McGraw-Hill.
Coker, R. E., This great and wide sea: Chapel Hill, University of North Carolina Press.
Coleman, A. P., 1926, Ice ages, recent and ancient: New York, Macmillan. (See the section on the Pleistocene.)
Collis, Stuart, 1954, The triumph of the tree: New York, Sloane.
De Castro, J., 1952, The geography of hunger: Boston, Little, Brown.
Finch, V. C. and Trewartha, G. T., 1949, Elements of geography: New York, McGraw-Hill.
*Gamow, G., 1941, Biography of the earth: New York, Viking Press.
———— 1952, The creation of the universe: New York, Viking Press.
Hawkes, J., 1951, A land: London, Cresset Press.
Hesse, R., Allee, W. C. and Schmidt, K. P., 1951, Ecological animal geography: New York, Wiley.
*Hoyle, F., 1950, The nature of the universe: New York, Harper.
Huntington, E., 1927, The human habitat: New York, D. Van Nostrand Co.
*Huxley, J., 1948, Man in the modern world: New York, New American Library.
———— 1953, Evolution in action: New York, Harper.
Mather, K., 1944, Enough and to spare: New York, Harper.
Mills, C. A., 1942, Climate makes the man: New York, Harper.
Montagu, A., 1950, On being human: New York, H. Schuman.
———— 1952, Darwin, competition and cooperation: New York, H. Schuman.
Moore, R. E., 1953, Man, time, and fossils: New York, Knopf.

information I give them, and also write short summaries of collateral reading. This last is very important and is really the open-ended feature of the course. I set a "par" amount of work that will give a respectable grade and then suggest that if students, through interest plus having available time, see fit to double "par" in their outside reading they will get an *I* or *A*. This is what the great majority do. Perhaps this is a low form of bait, but then again perhaps it isn't. You can't read an extra book or three or four additional magazine articles without getting something out of it.

In this course there are field trips and study of fossils, as might be expected in any work in historical geology. What is different, however, is the amount of reading the students do. This, itself, is enough to reveal possibilities for correlation and points of contact with other fields. As these books are read it becomes increasingly clear that geology is a part of the very fabric of life itself. I will try to be specific.

The Sea Around Us is read as a textbook after a consideration of the Ordovician. It brings to life the whole problem of the relationships of the sea and cosmopolitan climates.

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Huntington, E., 1927, The human habitat: New York, D. Van Nostrand Co.
*Huxley, J., 1948, Man in the modern world: New York, New American Library.
———— 1953, Evolution in action: New York, Harper.
Mather, K., 1944, Enough and to spare: New York, Harper.
Mills, C. A., 1942, Climate makes the man: New York, Harper.
Montagu, A., 1950, On being human: New York, H. Schuman.
———— 1952, Darwin, competition and cooperation: New York, H. Schuman.
Moore, R. E., 1953, Man, time, and fossils: New York, Knopf.

Osborn, F., 1952, Our plundered planet: Boston, Little, Brown.
———— 1953, The limits of the earth: Boston, Little, Brown.
*Simpson, G. G., 1949, The meaning of evolution: New Haven, Yale University Press.
———— 1953, Life of the past: New Haven, Yale University Press.
Smith, F. G. W., and Chapin, H., 1954, The sun, the sea, and tomorrow: New York, Charles Scribner's Sons.
Smith, H. W., 1932, Kamongo: New York, Viking Press.
Vogt, W., 1948, The road to survival: New York, W. Sloane Associates.
Webb, W. P., 1931, The Great Plains: Boston, Ginn & Co.

In addition to the above, various travel books are used, of which the following are examples:

Beebe, W., 1925, Jungle peace: New York, The Modern Library.
Moorehead, Alan, 1954, Rum Jungle: New York, Charles Scribner's Sons.

* Mentor Books in paper backs are available for these titles.

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THE GEOLOGICAL STUDIES OF ROLF WERNER JUHLE (1929–1953): IN MEMORIAM

J. D. H. DONNAY
The Johns Hopkins University

ABSTRACT. There is no longer any question that a program of geological studies should include a thorough training in the fundamental sciences. Some doubt lingers as to the feasibility of such a program. Juhle's example shows that it can be done—witness the six-year curriculum that led him to a Ph.D. degree at the Johns Hopkins University.

Rolf Werner Juhle matriculated at the Johns Hopkins University on September 25, 1947. He was one month under eighteen, but he was unusually well prepared. He came from La Plata High School and more than fulfilled the entrance requirements with his high-school credits: Algebra (2 years), Geometry (1 year), English (3 years), Latin (2 years), French (2 years), History (4 years), Science (3 years). In addition, he already had a good knowledge of German, which his mother had taught him to read at home and for which he got advanced-standing credit. He also owed her his knowledge of French, for this language was not offered at the school he had first attended, and she had transferred him to another high school where he could take it. Moreover, he had won a State Scholarship (which he was to keep for two years) in the School of Engineering. He registered as a candidate for the bachelor's degree in Chemical Engineering.

During his first two years he did not study any geology but concentrated on his preparatory subjects—mathematics, chemistry, physics—while also taking English Writing, Advanced German, Elements of Political Science, and Economics. At the beginning of his third year he transferred to the Faculty of Philosophy, with a University Scholarship (which he kept for three years), as a "new plan student" in the Department of Geoolgy. (Under this plan promising students were allowed to skip the bachelor's degree and to proceed directly toward the doctor's degree, which they could hope to obtain in a minimum of six years.) Juhle took two full courses in geology: General Geology and Crystallography-Mineralogy. He started attending the Geology Journal Club, where he was to be an attentive listener and inquisitive debater for the next four years. He continued to strengthen his scientific foundation by taking a third semester of calculus and a third year of chemistry, which included the one-year course in Physical Chemistry for chemistry majors (without laboratory) and the one-semester course in Crystal Structure and Crystal Chemistry (with laboratory). As cultural subjects he studied history and literature. On account of schedule conflicts he was permitted to take American (instead of English) Literature and the History of England instead of that of Western Civilization. With the exception of a second physics course (Experimental Spectroscopy), which he took in his fifth year, Juhle's general scientific preparation was completed by the end of this third year. For a would-be "hard-rock geologist," his preparation was second to none.

He began his university studies in 1947, two years before the report on geologic education was published by the Geological Society of America (Thiel et al., 1949). He blazed the way for the new curriculum. By the time the University adopted the Bronk Plan,[1] Juhle was well ahead of the game. He showed us that the new approach to geological training through fundamental sciences is both workable and desirable, provided the basic subjects are looked upon as valuable tools for future geological work, not as mere "requirements" to be satisfied or circumvented! Future generations of geologists will profit from his example.

Not only in the care with which he selected his courses but also in the quality of his work did Juhle excel. In his third year, while carrying the heavy load of 38 1/3 semester-credits (12 of them on an advanced level) and working 5 hours a week as a helper for the Maryland Geological Survey, he managed to receive H (Honor) for 11 units, A for 22, and B for 3 of the 36 units in which grades were given. The only course in which he obtained a B was the Survey of American Literature, a course which he had entered at mid-year. (Thorough in all his endeavors, he took the missing first half the following year.) We professors will always be first to concede that "grades are not everything," but we could not fail to be impressed by the performance of our young student.

The last three years of Juhle's program represent an intense specialization in geology. He took a large number of courses offered in the department. In his fourth year he earned the unbelievable total of 43 semester-credits, while continuing to put in 5 hours a week with the Maryland Survey to supplement the income of his University Scholarship. It is clear that Juhle was not only a very gifted person, but also a very hard worker. More than once he was known to skip a whole night's sleep, working for 36 hours in a row and thinking nothing of it—there was so much studying to be done, so much to learn!

In the second half of his fourth year he passed the Departmental Foreign Language Examinations, German in February and French in May, more than two years before the granting of the degree, thus setting another good example (the requirements call for one year). In May he also presented and passed the Departmental Comprehensive Examinations.

In his fifth year, when the time came to select a dissertation problem, Juhle was quite undecided for some time. On the one hand, he liked crystallography very much, had been going to it "like a duck to water," and wanted to determine a crystal structure by X-ray methods. On the other hand, he had spent several summers doing field work in Alaska, where there were many petrologic and structural problems to be solved. If he chose to work in Alaska, it also meant that he could complete the problem before entering the Army, since this work was considered essential from the military point of view. When the new professor of igneous petrology, Dr. A. C. Waters, joined the Geology Department, Juhle took his course and soon made up his mind. He came to my office to break the news to me—his dissertation would be on an Alaskan volcano, Mt. Iliamna, but some day he would still want to solve a crystal structure.

At the end of the fifth year, on May 26, 1952, Juhle stood his oral examination

[1] A plan that stresses the need to study fundamental subjects, named after the past president of the Johns Hopkins University, Dr. Detlev W. Bronk. It is a modification of the "new plan" mentioned above.

before the Physical Sciences Group. He was the first student to take this hurdle under the newly adopted Bronk Plan. The story of this examination illustrates Juhle's great conscientiousness. He did very well, so well indeed (particularly in chemistry, physics, and mathematics) that one of the geology professors was worry-

TABLE 1—JUHLE'S PROGRAM OF STUDY

		MATHEMATICS	CHEMISTRY	ENGINEERING & PHYSICS	GEOLOGY	OTHER
First Year 1947–48	I 14-12	Algebra & Trig. 3-0	General Chem. (incl. Qual.) 3-6	General Eng. 1-0 Descript. Geom. 1-6		English Writing 3-0 Adv. German 3-0 [Phys. Educ.] [4-0]
	II 15-12	Analyt. Geom. 4-0	General Chem. (incl. Qual.) 3-6	General Eng. 1-0 Eng. Drawing 1-6		English Writing 3-0 Adv. German 3-0 [Phys. Educ.] [4-0]
Second Year 1948–49	I 17-7	Calculus 4-0	Organic Chem. 3-3	General Phys. 5-3		Political Sci. 3-0 Military Sci. 2-1
	II 17-7	Calculus 4-0	Organic Chem. 3-3	General Phys. 5-3		Economics 3-0 Military Sci. 2-1
Third Year 1949–50	I 15-8	Adv. Calculus 4-0	Phys. Chem. 2-0		General Geol. 2-2 Crystallography 3-6 Journal Club 1-0	History of England 3-0
	II 17-11		Phys. Chem. 2-0 Crystal Struc. & Crys. Chem. 3-3		General Geol. 2-2 Mineralogy 3-6 Journal Club 1-0	History of England 3-0 Am. Literature 3-0
Fourth Year 1950–51	I 16-18				Inv. Paleontology 3-6 Adv. Mineralogy 3-6 Petrography 3-3 Struct. Geol. 3-3 Journal Club 1-0	Am. Literature 3-0 [Speech for Engs.] [1-0] audit
	II 16-15	GERMAN READING EXAMINATION: FEBRUARY, 1951 FRENCH READING EXAMINATION: MAY, 1951			Inv. Paleontology 3-6 Microsc. Petrog. 3-6 Petrology 3-3 Adv. Str. Geol. 3-0 Geophysics 3-0 Journal Club 1-0	[Public Speaking] [3-0] audit
		DEPARTMENTAL FINAL EXAMINATIONS: MAY 11–12, 1951				
Fifth Year 1951–52	I 11-6			Exp. Spectroscopy 1-3	Stratigraphy 3-0 Ore Deposits 3-0 Geochemistry 3-3 Journal Club 1-0	
	II 14-12			Exp. Spectroscopy 1-3	Reg. Tectonics 3-0 Ore Deposits 3-0 Geochemistry 3-3 Petrology 3-6 Journal Club 1-0	
		COMPREHENSIVE ORAL EXAMINATION (PHYSICAL SCIENCES GROUP): MAY 26, 1952				
Sixth Year 1952–53	I	NATIONAL SCIENCE FOUNDATION FELLOWSHIP: SEPTEMBER, 1952			Sedim. Petrology 3-3 Dissertation	
	II	PHI BETA KAPPA: APRIL, 1953			Sedim. Petrology 3-3 Dissertation	

FINAL ORAL EXAMINATION (PHYSICAL SCIENCES GROUP): MAY 3, 1953
PH.D.: JUNE 9, 1953
NATIONAL RESEARCH COUNCIL POST-DOCTORAL FELLOWSHIP: APRIL, 1953
NATIONAL SCIENCE FOUNDATION POST-DOCTORAL FELLOWSHIP: MAY, 1953

Each year is subdivided into two terms, marked I and II.
The numbers of lecture and laboratory hours per week are indicated, in that order, for each term and for each course.

ing lest Juhle might have set too high a standard for future generations of candidates! After the examination my wife and I, who had invited Juhle to have dinner with us on that memorable day, looked for him everywhere, but in vain. He had disappeared from the campus. Weeks later we received a letter from Alaska, in which he apologized, "since I did so badly in the exam, you will understand that I felt like hiding when it was over." When I saw him again in the fall, on his return from the field, and assured him that he had indeed made his professors proud before the Group, he smiled at me unbelievingly. So high were his standards, and so great was his modesty.

During his terminal year Juhle obtained both a National Science Foundation Fellowship and the University Scholarship. He gave up the latter. Although his dissertation demanded all his time, he still attended the course in Sedimentary Petrology, which was given for the first time by the newly appointed professor, Dr. F. J. Pettijohn. He was elected to Phi Beta Kappa in April, defended his dissertation on "The Iliamna Volcano and Its Basement" on May 3, 1953, and was granted the Ph.D. degree on June 9, 1953. He won two post-doctoral fellowships, one of the National Research Council and one of the National Science Foundation; he chose the former. His plans were to work in Alaska during the summer of 1953, then go to Berkeley and study under Professor Howel Williams.

On the day Juhle was to fly to Alaska, my wife saw him for the last time. She congratulated him on having his doctor's degree and commented on how nice it would be for him henceforth to be able to consider his work an end in itself—with no more examinations to spoil the pleasure of it. To this Juhle replied, "I am very sorry that this past year was such a rush and that I did not do a better job on my thesis. If I could do it all over again, I would take an extra year." He had said the same thing to Dr. Waters, who had directed his research.

Juhle's training in field work was just as remarkable as his theoretical and laboratory preparation. His interest in natural history arose early. As a boy raised on a farm at Ironsides, Maryland, he was curious and anxious to learn about everything. He and his three younger brothers were close friends and constant companions. He would take them out exploring, following runs, watching jack-in-the-pulpit digest insects, bringing back periwinkles or birds with broken wings to be mended. He turned into a collector of butterflies, stuffed birds, snakes. His brothers still own the collection of Maryland snakes he made with them. When the big timber was sawed for veneer wood, the woodman said to Mrs. Juhle, "One of your boys really understands the woods." Indeed, young Werner knew every tree by name, what soil it needed, and how it grew. He became the friend of Mr. Francis M. Uhler, biologist of the Patuxent Research Refuge, who helped him develop into an enthusiastic naturalist. His influence was so profound that Juhle had even thought of going to Cornell to prepare himself to enter the Fish and Wildlife Service. In the summer of 1948 Juhle did surveying work for the U. S. Geological Survey in Wyoming and Montana. The following year and every year after that, he did his field work in Alaska.

We who knew Werner Juhle liked him as a man as much as we admired him as a student and a scientist. Many happenings could be cited to illustrate his devotion to his family. I shall mention only one. From his own savings he paid off the balance of the mortage on his parents' farm—$2,000, a considerable sum of money

for a boy who had to count pennies to put himself through school. He made this payment without his parents' knowing it. His father did not find out until he went to the Farmer's Credit Association to make his payment and was told, "But, Mr. Juhle, Werner paid it all before he left for Alaska."

When Juhle disappeared at the end of the 1953 mapping season, he was known as an experienced and careful field man. During the search that followed, many anguished hypotheses were advanced to account for his failure to return to camp, but nobody believed there existed any creek that Juhle's sure foot could not negotiate, or any difficulty that his keen eye could not perceive. But Juhle had been driving himself hard all summer, probably to the limit of physical endurance. (His U.S.G.S. superiors could hardly believe that his party had actually mapped such a large area.) On that last evening he must have felt very tired. An unkind Fate let the accident happen—his foot did slip, and in a flash the torrent crushed him and carried him away. He rests in the place of his life work, among the rocks he loved so much and studied so well. Awed by his untimely death we revere his memory, forever mindful of all he taught us in his brief but splendid life.

ACKNOWLEDGMENTS. For the details of Juhle's boyhood I am indebted to his mother, Mrs. Bernhard Carl Juhle. For other information I wish to thank my colleagues and many former students. In the compilation and presentation of the biography itself I received much help from my wife, Dr. Gabrielle Donnay.

NOTE. On June 8, 1956, the United States Board on Geographic Names informed Mrs. Juhle that it had by formal decision approved the following name for official use by all agencies of the Federal Government:

"Mount Juhle: a mountain with an elevation of about 5,010 feet, in Katmai National Monument, about 3 miles northwest of Knife Peak; named for Dr. Rolf Werner Juhle who lost his life while doing field work in the area for the Geological Survey in 1953. Latitude 58° 22′ 45″ N., longitude 155° 09′ 30″ W."

REFERENCE CITED

Thiel, G. A. et al., 1949, Report of the Committee on geologic education of the Geological Society of America: Interim Proc. Geol. Soc. of America, pt. 2, p. 17–21.

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A LECTURE DEMONSTRATION OF LIMESTONE SOLUTION AND PRECIPITATION

MARSHALL SCHALK
Smith College

ABSTRACT. For classroom demonstration of the solution and precipitation of limestone, the writer places small pieces of calcite in a quart bottle of "sparkling" water, seals the bottle with a fresh cap to preserve the carbonation, and allows it to stand for at least 24 hours. If the liquid is then poured off and heated, a fine white precipitate forms.

The solution of limestone is often stressed in elementary courses as a form of weathering which operates at a relatively rapid rate and whose effects are easily visible. The chemical equations involved are stressed and contrasted with the far more complicated changes in the weathering of silicates. The usual chemistry-course demonstration of the relative solubilities of calcium carbonate and calcium bicarbonate starts with calcium hydroxide (lime water) and is therefore not directly comparable with the process in nature. For two years the writer has used a simple demonstration which requires no complicated apparatus but which does require preparation in advance of the class.

Necessary items are a quart bottle of "sparkling" water (charged, or soda water —Canada Dry works very well), a bottle capper and new bottle cap, some calcite cleavage fragments or pieces of limestone just small enough to be placed in the bottle, a beaker, and a bunsen burner or hot plate. The sparkling water should be thoroughly chilled in advance of opening. Immediately after opening it, the calcite or limestone is carefully dropped in and a fresh cap put on. The writer has not attempted any tests, but some of the better re-capping devices sold to preserve the carbonation of partly used bottles should serve just as well as a standard cap. Some carbon dioxide is of course lost during the insertion of the calcite. If the water has been chilled almost to the freezing point, and if the fragments are as large as possible and free of any powdered material, the loss is of no importance.

Under the conditions of the experiment, 24 hours is probably the minimum time necessary to dissolve enough bicarbonate to give a successful demonstration. After 17 hours, with 18 grams of calcite in the bottle, the air-dried precipitate weighed approximately 0.10 gram. After 66 hours the precipitate weighed 0.35 gram. A bottle prepared a year in advance gave a wet volume of 4 cc. of precipitate after settling and a dried precipitate weighing 0.65 gram. This larger amount obviously afforded a better visual demonstration, but the amount after 66 hours was ample. No systematic shaking of the bottles was undertaken, but they were up-ended occasionally after the calcite had been inserted.

When ready for the demonstration, the bottle should be thoroughly chilled, then opened in front of the class and the clear liquid carefully poured off into a beaker. The beaker is then placed over heat, visible loss of carbon dioxide occurs, and within twenty minutes a fine white precipitate begins to form. After it has settled, the precipitate may be tested with hydrochloric acid.

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A SPACE-SAVING METHOD FOR STORING BULK SPECIMENS

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ABSTRACT. Where space for storing specimens is limited, it may be helpful to use rotating bins like those built for hardware. Such bins have proved excellent for storing bulk material; however, they are not desirable for storing study sets.

When faced with limitations of store-room space for storing bulk mineral, rock, and fossil specimens, we found a solution in the use of rotating metal bins.

Several manufacturers offer rotating bins for the storage of parts and hardware. The one we selected is the "Rotabin" (made by the Frick-Gallagher Company, Wellston, Ohio), in which each unit consists of eight 34-inch circular sections rotating on a vertical shaft (Fig. 1). Each section is designed for a 500-pound load and comes divided into five parts. Easily attached extra dividers are available to make any desired compartment size. The rim of each section is slotted to hold card labels. The complete unit is about five feet high and offers more than seventy feet of shelf front in a three-foot square of floor space.

Fig. 1—A series of Rotabins containing specimens.

This method of storage has the following advantages:

1. It saves wall and floor space.
2. The movable dividers permit adjustment of the compartment size to fit the material. Thus no shelf space is wasted.
3. Specimens up to 5½ inches in smallest dimension may be stored.
4. There is complete separation between compartments, which prevents mixing of specimens.
5. The contents of all compartments are visible at or below eye level.
6. The instructor can stand in one place and "dial in" any desired compartment.

On the other hand, it has some disadvantages:

1. It is not desirable for storing study sets, since there are no removable trays or drawers.
2. The bin cannot be locked.

EDIT. NOTE: A recent communication from the manufacturer of the storage bin described here indicates that it is now possible to obtain drawers or removable pans to fit the bins, and that there are several styles of panels or swing doors for locking the bins.

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ADVANTAGES OF LARGE CHARTS IN LECTURE SECTIONS*

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ABSTRACT. Large charts are recommended for use in lecture sections. They do not require darkening the room, as is necessary for motion pictures or for the types of slide projectors most often used. They share with slides the advantages of permitting full discussion of one view before it is replaced by another. Moreover, it is possible to view several charts at once for comparative purposes, which is not possible with slides. Charts can be prepared with more care than blackboard drawings.

Almost everyone agrees that in lecturing to large groups visual aids are useful. However, the question arises as to what type of visual aid is most helpful.

Motion pictures are commonly used by lecturers, but they have some distinct disadvantages. For example, it is generally difficult for the students to take notes in a darkened room. Moreover, before the lecturer can fully develop a topic or the students can ask questions the scene has shifted. Quite apart from this time problem, the interested student often does not feel free to ask questions while the film is in progress since he is merely an anonymous voice in the darkness. Some students find the darkness conducive to sleep.

Most of these difficulties are overcome with the use of slides if the projector is the type that can be used efficiently in a well-lighted room. However, this type of projector is not commonly used. With large charts made of illustration board, size 30 by 40 inches, as many as two hundred students can see the drawings in a well-lighted lecture room. An important advantage charts have over even the best projector is the practicality of comparing several charts. For example, in illustrating stages in the development of landforms, the lecturer can readily contrast two or more charts at the same time.

For the average instructor, large charts have an advantage over blackboard drawings in that they can be prepared with more care and thus probably give a better three-dimensional effect. Not everyone has the impromptu skill of a W. W. Atwood, Sr., or an A. K. Lobeck. In addition, with the use of a finished drawing the attention of the student is directed to the subject matter rather than toward watching with fascination the artistic ability of the instructor.

It is, of course, true that much time will be taken up in the drafting of the charts, but once that is done they can be used to advantage repeatedly.

* Presented at the sixth annual meeting of the Eastern Section of the Association of Geology teachers, at West Virginia University, Morgantown, on March 29, 1956. This paper was part of a symposium on teaching aids in geology.

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A STUDY IN MAP INTERPRETATION: THE STRASBURG, VIRGINIA, QUADRANGLE

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ABSTRACT. The Strasburg, Virginia, quadrangle provides illustrations of geomorphic principles and regional geomorphology that may be useful in teaching. This quadrangle lies chiefly in the Shenandoah Valley, which is separated from the Blue Ridge by a resequent fault-line scarp. Within the valley differential erosion has etched out the synclinal Massanutten Range, within which subsidiary anticlinal and synclinal folds can be distinguished clearly. These various features are compared with similar one in other areas. Transverse drainage in the region is attributed to structural superposition. Other unusual features on the map are pointed out.

The writer is always pleased to have brought to his attention maps illustrating some geomorphic principle or some aspect of regional geomorphology, which may be used in class. With this in mind, and with the hope that some of his teaching colleagues may find the material useful, the following discussion of certain features depicted upon the Strasburg, Virginia, quadrangle[1] is written.

Regionally, almost the entire Strasburg map area lies within the Great Appalachian Valley of Virginia, more specifically within that part celebrated in history and romance as the Shenandoah Valley. The southeastern corner of the map shows a bit of the Blue Ridge Province underlain by pre-Cambrian crystalline rocks,[2] which have been thrust westward upon the generally weaker Paleozoic rocks of the Great Valley along the great Blue Ridge fault. Following erosion to a surface (Schooley) marked approximately by the summit elevations of the Blue Ridge and of the Massanutten Range, regional uplift allowed differential erosion, which has brought into relief the northwestward-facing front of the Blue Ridge contemporaneously with the excavation of the Great Valley. This Blue Ridge boundary is technically a resequent fault-line scarp. Its irregularity is perhaps due to its origin by erosion along a low-angle thrust fault, and it may profitably be compared with the straight Ramapo escarpment shown on the Ramapo, New York–New Jersey, quadrangle. The Ramapo escarpment is also a resequent fault-line scarp, but in this case the scarp has been developed by differential erosion along a steeply dipping normal fault separating weak Triassic sediments from more resistant older crystallines in what may be considered the northern continuation of the Blue Ridge.

Broadus Mountain (Rectangle 8) and similar ridges continuing its trend to the northeast are expectable features along an over-thrust boundary. They apparently are flat-iron types of ridges developed upon the edges of Paleozoic beds dragged upward beneath the thrust. Should the fault, however, run along the west

[1] Strasburg, Virginia, quadrangle. Scale 1: 62,500. Contour interval 40 feet. Edition of 1950. U. S. Geological Survey. For oblique aerial photographs of this area see Rich (1939), Figs. 9–12.

[2] See the *Geologic Map of the Appalachian Valley in Virginia*, by Charles Butts (Virginia Geological Survey, 1933).

side of Broadus Mountain, these ridges would be formed on Paleozoics lying on top of the thrust plane in unconformable contact with the crystallines to the southeast. In any case their height would lead the writer to place these ridges in the Blue Ridge Province.

The most striking features shown are probably the three parallel ridges trending northeastwardly across the center of the area. These are part of the Massanutten group, which extends to the southwest thirty miles beyond this map. Those familiar with Appalachian topography will recognize that the Massanutten Range stands above the surrounding Great Valley as a result of differential erosion. Massanutten owes its origin to two factors: the great resistance of the Silurian Tuscarora quartzites forming it and the deep synclinal folding which dropped the quartzite below the level of Schooley erosion. Later uplift and differential erosion lowered all the region on weak limestones and shales to the level of what may be called the Valley peneplane, leaving Massanutten as a large synclinal remnant in the midst of the Great Valley. Here was a perfect topographic theater for the marches and counter-marches of Stonewall Jackson and the famous ride of General Sheridan.

As a rather unusual kind of isolated synclinal remnant, Massanutten could serve as a type of which Schunemunk Mountain on the Schunemunk, New York, quadrangle is a closely similar example. Becraft Mountain on the Kinderhook, New York, quadrangle, where a synclinal remnant of Middle Paleozoic limestone is preserved east of the Hudson River, well separated from the main limestone outcrop west of the River on the Catskill, New York, map area, is another much smaller example of this sort of thing. If it were still popular to invent names for type examples of geomorphic features, these might well be called massanuttens.

Massanutten, however, is not a simple synclinal mass, as reference to the Strasburg map indicates. Attention may first be directed to Rectangle 5, where the topography of the well-named Little Crease Mountain depicts a subsidiary anticlinal fold in the Tuscarora. East of Little Crease Mountain, Mill Run clearly flows in a valley developed upon a syncline. These southwestward-pitching paired folds affect the topography along their axes almost to Seve [Seven] Fountains. Followed northward along the ridge to Buzzard Rock and Richardson Knob, the structure here demands the end of a southwestward-pitching synclinal fold, but the peculiarly situated gorge of Passage Creek at the Blue Hole has masked the expectable topographic contrast in slopes on the two sides of the curved ridge. Immediately to the west, however, at Meneka Peak are seen the contrasting slopes of a pitching anticlinal nose, and a mile beyond at Signal Knob the features are clearly those of a pitching syncline. The topographic evidence at Little Crease Mountain, Meneka Peak, and Signal Knob is ideal. From it the map reader with confidence interprets Three Top Mountain and its southwestward continuation, Powell Mountain, as homoclinal ridges developed on the southeast-dipping Tuscarora on the northwest limb of the Signal Knob syncline. Greater interest attaches to Green Mountain, for it is clearly an anticlinal ridge developed along the southwestward-pitching Meneka anticline. Judging from the crest-line elevation of Green Mountain, the lowest point on the anticlinal axis must be around 1500 feet at Mine Gap, from which the axis ascends southwestward to an elevation just over 2600 feet at Opechee Peak. Just south of Opechee Peak the head of Buck Run

bends southwestward parallel to the anticlinal axis, suggesting that the Tuscarora has been breached and that the development of a subsequent anticlinal valley has started.

To the writer the most interesting item for discussion concerns the origin of the transverse streams crossing the Little Crease Mountain and the Green Mountain anticlinal ridges. Two streams are shown flowing northwestward across the Crease Mountain anticline, and the contours show at least two and possibly four dry valleys also crossing the anticline. Four streams flow southeastward across the Green Mountain anticline, and Boyer Gap and an unnamed gap appear surely to be windgaps made by two streams once crossing the anticline in a southeasterly direction. Streams still head in these windgaps. Passage Creek, to which all the discordant streams mentioned are tributary, is a longitudinal stream flowing northeastward along the axis of the major syncline in a subsequent position. To explain this discordant drainage the writer advances the hypothesis that at the time of Schooley (Summit) peneplanation in this area, the Tuscarora quartzite would have made a pattern of low linear monadnock ridges standing somewhat above the peneplane on the weaker rocks. Between Powell–Three Top Mountain and Massanutten Mountain there would have been a longitudinal lowland probably drained by the ancestral Passage Creek. In those low places structurally, where the transverse tributaries now cross, the Tuscarora was covered by overlying weak beds essentially conformable to it. Thus with regional uplift the transverse streams became superposed across the Tuscarora, a hard rock formation, at a lower level in the same structure. Since then, as the windgaps indicate, some adjustment has taken place. The anticlinal superposition described above is commonly called structural superposition and is constantly occurring in regions of Appalachian-type folds. It takes place at right angles to the structure, and in the Appalachians, as breaching of the anticline occurs, it may result in paired gaps aligned in a southeastward direction through opposed homoclinal ridges. It is a process working against the perfect adjustment of drainages to folded structures. Except for the possible presence of disconformities within the structure, this type of superposition might perhaps be called conformable superposition in contrast to the disconformable superposition well illustrated on the DeQueen, Arkansas, map. There southward-flowing streams transecting the Ouachita folds were superposed from overlapping Cretaceous beds, which still are present in the southern part of the map area.

Many other features on the Strasburg map call for discussion. Especially puzzling is the peculiarly situated gorge at Blue Hole, by which Passage Creek escapes from within the Tuscarora on the very nose of the syncline. Unusual as this position is, the head of Big Run, a stream opposed to Passage Creek at the very southwest end of the same synclinal basin, is in a similar structural position, as is shown on the Mt. Jackson sheet. Both the South Fork and the North Fork of the Shenandoah River show beautiful entrenched meanders. Those of the North Fork in the Seven Bends district are noteworthy for the great length of their arms. These and the similar "long-armed" meanders of Conodoguinet Creek, shown on the Harrisburg, Pennsylvania, quadrangle, have been discussed by Strahler (1946).[3] The writer will not mention them further except to refer the reader to Rich's excellent photograph (1939, Fig. 12), in which a cutoff is clearly

[3] Figure 2 in this paper is a reproduction of Figure 12 of Rich (1939).

depicted. He will leave the search for other possible cutoffs to the reader. In conclusion, how about Round Hill? It is a simple residual, or is it a more specialized form, a volcanic neck like the Mole Hill, shown on the Harrisonburg map not far to the southwest?

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OBITUARIES

STANDARD G. BERGQUIST, 1892–1956. The death of Dr. Stanard G. Bergquist, president of the Association of Geology Teachers in 1955–56, deprived the Association of an active and enthusiastic worker in its affairs. Dr. Bergquist, a member of the East Central Section, was vice president of the national Association in 1954–55. He died on March 31, 1956, less than two months after his election as president.

According to the constitution, the vice president is responsible for arrangements for the annual meeting of the Association. Dr. Bergquist accepted this responsibility and discharged it exceptionally well. With "The Impact of General Education on the Curriculum in Geology" as the theme of the meeting, he solicited well-qualified speakers to develop it, put the program together, and saw that the details of time and place were planned. The result was the highly successful symposium at New Orleans, where attendance was on a standing-room-only basis, papers were attentively listened to, and discussion was lively. This session, although it was in competition with concurrent technical sessions of the Geological Society of America and lasted less than three hours, became one of the most talked-about programs of the New Orleans convention. This sort of stimulating presentation and exchange of ideas is precisely what the Association of Geology Teachers was formed to promote, and Dr. Bergquist contributed materially to its advancement.

If the continuing work of the Association can be carried forward with the same enthusiasm and willingness to work that Dr. Bergquist displayed, we need have no fear for its future.—ROBERT L. BATES

LYNNE KELSEY, 1899–1956. Lynne Kelsey died unexpectedly of a heart attack at his home in Poughkeepsie, New York, on May 18, 1956. He had spent the day at his usual duties as teacher of general science in the Poughkeepsie High School.

Lynne was born in Winthrop, New York, July 2, 1899, and after graduating from St. Lawrence University in 1924 taught briefly at Hornell, New York, before coming to the Poughkeepsie High School, where he spent 29 years. As the teacher of earth science he fully recognized the importance of field experience, and was outstanding in his efforts to provide field work for his students. He was also active in the work of the Boy Scouts of his area.

He will be remembered by those who attended meetings of the Eastern Section of the Association, for his succinct comments on the problems and rewards of the high-school earth science teacher.—A. S. WARTHIN, JR.

JOHN LYON RICH, 1884–1956. Dr. John Lyon Rich, Emeritus Professor of Geology at the University of Cincinnati, died suddenly, of a heart attack, on May 21, 1956. He was a member of the East Central Section of the Association of Geology Teachers. Because of his outstanding position in the geological profession the Association conferred honorary membership upon him at its 1954 annual meeting (held in Columbus, Ohio, in January, 1955).—MILDRED FISHER MARPLE

TRANSACTIONS
OF THE
ASSOCIATION OF GEOLOGY TEACHERS

CENTRAL SECTION

The sixteenth annual meeting of the Central Section of the Association of Geology Teachers was held April 23, 1956, at Wheaton College, Wheaton, Illinois.

The group was welcomed by Professor Boardman of the Wheaton Geology Department and by President Edmund of Wheaton College.

Section President Spitznas convened the business meeting at 9:30 A.M. The minutes of the fifteenth annual meeting and the treasurer's report were read and approved. The Committee to Survey Meeting Dates reported that the membership slightly favored mid or late February as a meeting date. President Spitznas reported on the meeting of the national Executive Committee of the Association, held in New Orleans in November.

The Nominating Committee presented a slate of officers (see inside back cover), and the secretary was instructed to cast a unanimous ballot for these nominees. Donald C. Boardman was elected section representative on the national Nominating Committee.

The Budget Committee recommended that funds be allocated as follows: office expenses, 30 per cent of net income; annual meeting expenses, 10 per cent; contingency fund, 10 per cent, contribution to the AGI, $15. It was also recommended that $150 be set aside in a Reserve Fund, from which expenditures may be authorized only by vote of a majority of the members attending any regular meeting of the section or by a majority of votes resulting from a mail ballot sent to the membership. The report was amended to include the provision that the Reserve Fund be placed in some income-producing account or in government bonds. The membership accepted the report as amended.

H. E. Hendricks made the plea that each of us as individuals also support the AGI.

F. M. Fryxell sent the suggestion that the Association's name be changed to "American Association of Geology Teachers." It was briefly discussed and tabled.

Election of six new members was announced.

President Spitznas reported that the AGI directory of college and university geology departments would be published in June. A committee of the AGT has worked closely with the AGI in revising this directory.

President Spitznas reported that a Leland Horberg Memorial Fund, provided by some of Horberg's friends at Augustana College, had been tentatively offered to the AGT. It was suggested from the floor that the best use of the fund might be the publication of one of the numbers of the *Journal of Geological Education* as a memorial volume. It was moved, seconded, and approved that the Central Section recommend to the national Association the establishment of a general memorial fund in which could be consolidated all small memorial funds contributed in the future. Otherwise, the multiplication of many small funds will prove to be quite an administrative burden.

Itineraries for the student field trip held in connection with the meeting were provided by the Illinois State Geological Survey. It was moved, seconded, and approved that the secretary express the section's thanks to George Wilson of the Survey staff, who prepared them.

Thanks were voted to the Geology Department of Wheaton College for its hospitality.

The business meeting was adjourned at 10:45 A.M.

The topic of the main program, prepared by Vice President Hussey, was: "A Consideration of Our Product."

Donald C. Boardman briefly outlined the geology program at Wheaton College. Since its beginning in the 1920's it has been closely associated with the Chemistry Department. Emphasis is on general principles and field work. All majors take a year of chemistry and physics, and math through calculus.

Chalmer J. Roy keynoted the program with a talk that surveyed what a geologist is and what he needs to know. If an educated man is one who can learn what he needs to know to be a successful citizen and successful in his profession without taking courses, then an educated geologist is an educated man who has prepared himself to work in the field of geology. No curriculum in and of itself, no matter how good, can insure that any student will be an educated geologist.

Geology teachers should require geology students to take as much basic science as possible, even at the expense of a little geology. For work on which geologists could be used to advantage—petroleum-reservoir engineering, for example—engineers are now used because most geologists don't know enough about mathematics and the physics of rocks.

There was then general discussion on the following subtopics. A brief summary is given of important points mentioned.

1. What should the product be? H. E. Hendricks, leader. Geology requires interpretative thinking above almost everything else—a type of thinking that picks out the important and significant things in a given situation. Courses should emphasize how a geologist thinks. Graduates do not rise or fall only on the basis of their technical knowledge. Their abilities to express their ideas and cooperate with their associates are also important.

2. Requirements in basic sciences. P. W. Harrison, leader. Basic science courses are tools to use in understanding geological processes better. They are all important and should never be neglected.

3. Geology courses, required and elective. K. G. Nelson, leader. The problem is frequently one of too many courses. The small colleges, which of necessity have had to limit the number of courses offered, actually have a real advantage here. The larger schools can take a lesson from the small colleges in limiting course offerings to undergraduates.

4. Courses in applied science or engineering. J. R. Berg, leader. Though there is little room for such courses and they should never be taken at the expense of a basic course in geology or other science, many are valuable. Aerial photo-interpretation, petrographic microscope methods, and surveying are probably the most valuable among courses of this type.

5. Production of scientists versus technicians. D. C. Boardman, leader. An important part of any education is development of an appreciation of the philosophy of science. Those who would be professional geologists and not geologic technicians need to appreciate this philosophical background. It should be emphasized in every course.

After dinner Olin G. Bell, who is in charge of hiring geologists for the Humble Oil and Refining Company's exploration department, spoke on what he expects of a young geologist. If the newly hired geologist has a thorough knowledge of fundamentals he can, working under an experienced geologist, be assigned to many different phases of petroleum exploration. He should be able to undertake a field investigation and write a report that is readily understandable without a visit to the area by the district geologist. He should have those personal qualities of honesty, integrity, and perseverance which, combined with geologic competence, make a superior employee.

Respectfully submitted,

DOROTHY J. GORE, *Secretary-Treasurer*

EAST CENTRAL SECTION

The East Central Section of the Association of Geology Teachers held its annual meeting on April 27–28, 1956, at Indiana University, Bloomington, Indiana.

Following an informal coffee hour Friday morning, the group inspected the facilities of the Indiana Geological Survey.

In the afternoon, with R. H. Mahard as moderator, there was a symposium on the subject: "The Geology Curriculum Under the Impact of the General Education Program." George Crowl spoke for the liberal-arts colleges and D. F. Eschman for the universities. Car trouble prevented John Coash, the third panelist, from reaching Bloomington in time to speak. A general discussion followed the presentation of the panelists, during which it was agreed that an undergraduate curriculum of sufficient depth and breadth leaves little time for student-selected electives, but that this is not necessarily a bad situation.

The group then toured the laboratories of the Geology Department of Indiana University.

The annual business meeting was held at the banquet Friday evening, with President Grant T. Wickwire presiding. Dr. Wickwire opened with a greeting to those present and a brief and interesting address calling attention to the idea that we must consider not only the subject that we are teaching at present, but also those topics that we are not including. Minerals that were hardly thought of twenty years ago are now in great demand. The geologist must be always looking ahead and not only keeping abreast of new developments but leading the vanguard of research.

It was announced that an endowed issue of the *Journal of Geological Education* is to be devoted to the subject of teaching elementary mineralogy.

Vice President R. H. Mahard made his report, opening with an expression of thanks to our hosts, the members of the Geology Department of Indiana University. Dr. Mahard mentioned the symposium at the national AGT

meeting at New Orleans and expressed the hope that members would find the discussion at this section meeting equally helpful.

Dr. Wickwire asked the members to bear in mind the Neil Miner Teaching Award and to contact either R. P. Goldthwait or C. B. Moke with suggestions for nominations.

M. F. Marple read the treasurer's report and announced the officers for next year (see inside back cover).

It was moved by K. K. Landes, seconded by Wayne Lowell, that the president hereafter instruct the nominating committee to contact prospective nominees and obtain clearance before placing their names on the ballot. Motion passed.

A letter from the national secretary was read asking that a representative of the East Central Section be named for the national nominating committee. V. E. Nelson was nominated by Dr. Lowell, seconded by C. L. Bieber. No other nominations were made, and Dr. Nelson was appointed.

Dr. Nelson observed that the Association serves a unique purpose; that the section meetings are, in some respects, of greater importance than the national meeting; and that everyone present should see that next year's meeting receives better support. Dr. Mahard added a similar plea.

Dr. Landes re-affirmed the invitation of the University of Michigan for the 1957 meeting. On motion of Dr. Crowl, seconded by Dr. Fisher, the invitation was accepted.

Some discussion of dates brought out the opinion that a time earlier in the spring would be more convenient, in spite of the fact that the weather might not be as comfortable for the field trip.

Dr. Bieber suggested that a questionnaire be sent to the section members asking their preference as to time and subject matter for the program.

A slide symposium followed.

A field trip to several of the famous "Indiana limestone" quarries, and to one of the mills where the stone is cut and prepared for market, occupied Saturday morning.

Respectfully submitted,

MILDRED F. MARPLE, *Secretary-Treasurer*

EASTERN SECTION

The sixth annual spring meeting of the Eastern Section of the Association of Geology Teachers was held at Morgantown, West Virginia, on March 29–30, 1956. The Geology Department of West Virginia University was host. Two symposia, two field trips, and the annual dinner were features of the meeting. Twenty-seven geologists attended.

The first symposium was devoted to "Teaching Aids in Geology." Maurice Rosalsky of the City College of New York demonstrated some advantages of large charts over motion pictures, slides, or blackboard drawings for use in lecture sections. Kurt Lowe of the City College of New York showed transparent models made by students, a great help in visualizing the optical properties of minerals. John Ludlum of West Virginia University spoke on "Philosophic and Geometric Perspectives in Teaching Structural Geology." He advocated that physical and historical geology be followed immediately by structural geology, which he feels is a good test of a student's reasoning power.

The second symposium dealt with the teaching of elementary mineralogy. The papers and discussion of them are printed in full in Part 2 of this issue of the *Journal*. Those in attendance at the symposium felt that it made a vital contribution to the educational status of elementary mineralogy.

The first field trip included a study of Pennsylvanian cyclothems, Pennsylvanian fossils, and local erosional surfaces. The second field trip was a visit to a modernized coal mine.

On Saturday, April 14, the Eastern Section sponsored an all-day visit to the Geology Department of Bryn Mawr College, Bryn Mawr, Pennsylvania. Geologists from Bryn Mawr, Dickinson, Franklin and Marshall, Lafayette, and Rutgers participated. The purpose of such visits is for members of the Eastern Section to become better acquainted with different philosophies and methods of geology teaching at various colleges and universities in the area.

Respectfully submitted,

ARTHUR MONTGOMERY, *Vice President*
and MAURICE B. ROSALSKY,
Secretary-Treasurer

NEW ENGLAND SECTION

The New England Section of the Association of Geology Teachers held its fourth annual meeting on April 13–14, 1956, at the University of Maine, Orono, Maine.

On April 13, after an open house and dinner as guests of the University, Section President Robert L. Nichols, of Tufts College,

gave the presidential address on "Teaching Methods and Aims in Elementary Geology at Tufts College."

The morning session on April 14 opened with a discussion on field geology. Papers on field geology courses were given by Glenn Stewart, John Sanders (in absentia), and Marland Billings. Wroe Wolfe presented a paper on "Combining a Research Program with Field Geology Instruction," and Arthur Socolow gave one on "Experiences and Values of an Economic Geology Field Course."

This discussion was followed by one on historical geology, with a paper by George Bain on "The Lyell Approach to Historical Geology."

In the afternoon there was a session devoted to photogeology. William Fischer, of the U.S.G.S., spoke on "Photogeology in the Undergraduate Geology Curriculum." The use of air photos in geology courses was described by Louise Kingsley (Wellesley), John Sanders (Yale, in absentia), and Harold Young (Maine).

A slide symposium concluded the program.

New officers were elected (see inside back cover), and William H. Dennen (Massachusetts Institute of Technology) and Freeman Foote (Williams College) were named to the Nominating Committee.

Respectfully submitted,

MARSHALL SCHALK, *Secretary-Treasurer*

FAR WESTERN SECTION

The Far Western Section of the Association of Geology Teachers held its annual meeting on March 24–25, 1956, at Santa Barbara College of the University of California, at Goleta, California.

The morning session on March 24 opened with a welcome by the College administration and a business meeting. This was followed by a discussion of "Geology and General Education Outside the Colleges," with George J. Bellemin (Los Angeles City College) as chairman. The following papers were presented: "The Place of Geology at the Pre-Collegiate Level," by Wesley D. Gordon, San Lorenzo School District; "A Layman's Discovery of a Vertebrate Fauna," by Philip E. Gordon, student at San Jose State College; "Earth Science in Adult Education," by Selmer O. Wake, Director of Adult Education, Santa Barbara High School District.

In the afternoon there was a demonstration of modern audio-visual aids and a color slide symposium. This was followed by a symposium on "Geology and General Education in the Colleges," with James F. Richmond (Los Angeles State College) as chairman. A. O. Woodford of Pomona College presented a paper on "How Is the Beginning Geology Course Being Taught, and Should It Be Taught That Way?" Comments were made by Alfred Livingston, Jr., Los Angeles City College; Norman R. Anderson, College of Puget Sound; Norman H. Dolloff, San Jose State College; Clement D. Meserve, Glendale City College; and F. Beach Leighton, Whittier College.

On March 25 there was a field trip conducted by Richard V. Fisher and Robert M. Norris of Santa Barbara College. The group followed a 35-mile route to examine the structure and stratigraphy of the Santa Ynez Range (Transverse Range Province) and the geomorphology of the Santa Barbara Coastal Plain.

By mail ballot in May new officers were elected (see inside back cover) and Ian Campbell was named representative to the national Nominating Committee.

Respectfully submitted,

ROBERT M. NORRIS, *Secretary-Treasurer*

SOUTHEASTERN SECTION

The first meeting of the Southeastern Section of the Association of Geology Teachers was held at 5 P.M., November 7, 1955, at New Orleans, Louisiana, following the annual meeting of the national Association.

The following matters were considered:

The new by-laws of the Southeastern Section were presented and unanimously adopted.

Officers, elected by mail ballot, were requested to serve until the spring meeting in 1957. This was unanimously passed.

It was proposed and adopted that a concerted drive be made by the members of the section present to publicize the activities of the Association among the educational and professional institutions of the Southeast, in order to increase membership in the newly formed section. Membership blanks and copies of the national constitution and the section by-laws were distributed for this purpose.

The success of the symposium held earlier the same afternoon in New Orleans indicated the interest that all persons in the geological professions have concerning the present status of geology in the academic curriculum, and in matters pertaining to methodology and course

content. It was proposed and seconded that a similar symposium be held in conjunction with the regional meeting of the GSA in Tallahassee, Florida, on March 22–24. The resolution was unanimously passed.

President Lester appointed Richard Priddy, of Millsaps College, to arrange with Gordon Atwater, program chairman for the GSA meeting, for a suitable time during the sessions. Dr. Priddy was also given responsibility for the development of the symposium.

The first annual spring meeting of the section met in conjunction with the regional meeting of the Southeastern Association of the GSA in Tallahassee, Florida, on March 22–24, 1956.

A symposium under the auspices of the Southeastern Section of AGT was held on Friday afternoon, March 23. The chief topic of discussion was the problem of how we can better get our subject before the people. An informative paper on this subject was given by Robert L. Bates, entitled "Geology in the Public Eye."

Richard Priddy of Millsaps College demonstrated crystallographic models for classroom use and a newly devised technique for projection onto a screen of interference figures in motion as the stage of a petrographic microscope is rotated.

There followed an informal discussion on administrative and staffing problems facing college and university departments of geology.

Respectfully submitted,

ELDON J. PARIZEK, *Secretary-Treasurer*

NOTES AND NEWS

ANNUAL MEETING OF THE ASSOCIATION. In conjunction with the annual meeting of the Geological Society of America, the Association of Geology Teachers will meet in Minneapolis, Minnesota, on the afternoon of November 1, 1956. After a short business meeting a symposium on geological education will be presented, with papers by Chalmer J. Roy, Herbert Hendricks, Keith M. Hussey, Donald Boardman, B. F. Howell, Jr., and Guy Daniels. J. Robert Berg, acting president of AGT, who has prepared the program, will preside. Chalmer J. Roy will act as moderator.

FACSIMILE REPRINT OF PLAYFAIR'S *ILLUSTRATIONS*. John Playfair's famous work, *Illustrations of the Huttonian Theory of the Earth*, was published in Edinburgh in 1802. Although it is often quoted, it has not often been read by present-day students of geology because it has not been widely available. Now this need no longer be true. The University of Illinois Press has published a fascimile reprint (1956, price $4.50), with an Introduction, by George M. White, that includes biographical sketches of both Hutton and Playfair and references to some of Playfair's most famous passages. Geology teachers will be grateful to the University of Illinois Press and to Professor White for this attractive reprint of a work that has played a great role in the development of geological thought.

The ASSOCIATION OF GEOLOGY TEACHERS was founded in the Middle West in May, 1938. In November, 1951, it was organized as a national association, under which there are at present six organized regional sections: Central, East Central, Eastern, New England, Far Western, and Southeastern. An annual meeting of the national association is normally held in the fall, and sectional meetings are held in the spring.

The purpose of the Association, as stated in its Constitution, is "to foster improvement in the teaching of the earth sciences at all levels of formal and informal instruction, to emphasize the cultural significance of the earth sciences, and to disseminate knowledge in this field to the general public."

Anyone concerned with geological education, formal or informal and at any age level, is invited to apply for membership. *Inquiries should be addressed to the national secretary,* C. E. PROUTY, Department of Geology, University of Pittsburgh, Pittsburgh 13, Pennsylvania.

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